2013 Building Energy Efficiency Standards
45-Day Language Hearing

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Reference Appendices

History:

- Joint Appendices were introduced in 2005 Standards; had only four chapters:
- JA1 – Glossary
- JA2 – Reference Weather/Climate Data
- JA3 – Time Dependent Valuation (TDV)
- JA4 – U-factor, C-factor, and Thermal Mass Data

Served as common reference for all Standards related documents

Reference Appendices

History:

- The document was renamed Reference Appendices in the 2008 Standards and was expanded to include:
  - Joint Appendices (JA)
  - Residential Appendices (RA)
  - Nonresidential Appendices (NA)
- This allowed moving all material from the Residential and Nonresidential ACM manuals that were not related to compliance software approval.
- The document now serves as common reference for all standards related documents while allowing the ACM Manuals for the sole purpose of compliance software development and approval.

Reference Appendices

- Joint Appendices (JA)
- Residential Appendices (RA)
- Nonresidential Appendices (NA)

Reference Appendices

Joint Appendices

- JA1 – Glossary
- JA2 – Reference Weather/Climate Data
- JA3 – Time Dependent Valuation (TDV)
- JA4 – U-factor, C-factor, and Thermal Mass Data
- JA5 – New - Technical Specifications For Upgradeable Setback Thermostats
- JA6 – HVAC Fault Detection and Diagnostic Technology; used to be called Charge Indicator Display; mostly the same content
- JA7 – New: Registry Requirements - Deleted: Used to be Installation Procedures for Medium-Density, Closed-Cell Spray Polyurethane Foam (SPF) ; information moved to RA 3.5 and JA 4
- JA8 – Testing Of Light Emitting Diode Light Sources
- JA9 – Qualification Requirements for Low Leakage Air Handling Units

Reference Appendices

Residential Appendices

- RA1 – New: Special Case HERS Procedures. Used to be HVAC Sizing; the information has been moved to the RACM Reference Manual
- RA2 – Residential HERS Verification, Testing, and Documentation Procedures
- RA3 – Residential Field Verification and Diagnostic Test Protocols
- RA4 – Eligibility Criteria for Energy Efficiency Measures
- RA5 – Deleted: Used to be Interior Mass Capacity; the all electric package has been deleted so this appendix is not needed anymore

Reference Appendices

Nonresidential Appendices

- NA1 – Nonresidential HERS Verification, Testing, and Documentation Procedures
- NA2 – Nonresidential Field Verification and Diagnostic Test Procedures
- NA3 – Fan Motor Efficiencies
- NA4 – Compliance Procedures for Relocatable Public School Buildings
- NA5 – Deleted: Used to be Overall Envelope TDV Energy Approach; this will become a compliance option to be developed after adoption (Envelope Tradeoff Procedure)
- NA6 – Alternate Default Fenestration Procedure to Calculate Thermal Performance
- NA7 – Acceptance Requirements for Nonresidential Buildings
- NA8 – Illuminance Categories and Luminaire Power
- NA9 – New: Nonresidential Fault Detection and Diagnostics

Reference Joint Appendix JA1
GLOSSARY

Definitions

- Deleted obsolete terms
- Modified existing terms
- Added key terms used throughout Reference Appendices
  - Air Barrier and Air Leakage
  - Building Commissioning
  - Continuous Insulation
  - Data Registry
  - Fenestration
  - Global Warming Potential/Value
  - Hood
  - Lighting
  - Micro-channel/min-split heat pumps
  - Nonres building occupancy types
  - Particle size efficiency
  - Pressure boundary
  - Replacement air
  - Roof recover board
  - Vapor retarder class

Reference Joint Appendix JA2

JA2 REFERENCE WEATHER/CLIMATE DATA

- Updated climate zone designs conditions
- Included city zip code descriptions
- Removed description of WYEC2 climate/weather data format

Reference Joint Appendix JA3

JA3 TIME DEPENDENT VALUATION (TDV)

- Updated TDV statistical data for res & nonres buildings

Reference Joint Appendix JA4

JA4 U-FACTOR, C-FACTOR, THERMAL MASS

- Added new section for R-values and U-factors of Spray Polyurethane Foam (SPF) Insulation
  - Closed & Open cell SPF
- Updated U-factor tables to capture proper insulation types
  - Added new insulation alternative for nonres metal framed walls
- NOTE: Reference U-factors for assemblies can be updated at any time with valid support information.

Reference Joint Appendix JA5

JA5 Technical Specifications
For Upgradeable Setback Thermostats

- 5.1 - Introduction
- 5.2 - Required Functional Resources
- 5.3 - Functional Descriptions
- 5.4 - The HVAC System Interface
- 5.5 - Terminology

Reference Joint Appendix JA6

JA6 HVAC FAULT DETECTION AND DIAGNOSTIC TECHNOLOGY

Appendix renamed to accommodate other devices besides CID

- JA6.1.2.4 Optional functionality section revised to include more options
  - JA6.1.2.4.1 Self Diagnostic Reporting - new
  - Data Access – new
- Table JA6.1-1 Target Temperature Split – added
- JA6.2 Saturation Pressure Measurement Sensors – added

Reference Joint Appendix JA7

JA7 REGISTRY REQUIREMENTS (NEW)

New appendix created to specify requirements for standard functionality and technology for data registries that provide compliance document registration services

- Roles and responsibilities
- Compliance document registration procedures
- Document revision requirements
- Electronic and digital signature requirements
- Data Exchange requirements
- Approval of Data Registries and Approval of Software used for Data Input to Data Registries

Reference Joint Appendix JA7

JA7 INSTALLATION PROCEDURES FOR SPF (OLD)

- Section removed, relocated and updated to RA 3.5

Reference Joint Appendix JA8

JA8 QUALIFICATION REQUIREMENTS FOR RESIDENTIAL LUMINAIRES USING LED LIGHT SOURCE

- Citing IES LM-79-2008 (testing); IES LM-80-2008 (definitions); ANSI/IES RP-16-2010 (definitions)
- Kept testing lab requirements
- Requirements for Color Correlated Temperature (CCT), CRI, minimum efficacy
- Moved Table 150-C, Sections 119, 30(d), and 150(k) requirements to JA8

Reference Joint Appendix JA9

JA9 QUALIFICATION REQUIREMENTS FOR LOW LEAKAGE AIR-HANDLING UNITS (NEW)

- Applicable to air-handling units rated to move less than 3,000 cfm
- Equipment types: furnaces, heat pumps, air conditioners
- Method of test: ASHRAE Standard 193
- Testing laboratory: compliance with ISO Standard 17025
- Nominal air-handling unit airflow 400 cfm per nominal ton of cooling capacity or 21.7 cfm per kBtu/hr (for heating-only)
- Leakage criterion: equal to or less than1.4% of nominal air-handling unit airflow.

Reference Residential Appendices RA1

RA1 SPECIAL CASE RESIDENTIAL FIELD VERIFICATION & DIAGNOSTIC TESTING

- Moved HVAC sizing procedure to res ACM reference manual
- RA1.1 Special Case Protocol Approval requirements
- RA1.2 Included new special case refrigerant charge method for Liquid Line Temperature Charging Method
  - Micro-channel air condensers
- RA1.3 Included Winter Setup for the Standard Charge Measurement Procedure

Reference Appendices RA2

RA2 HERS VERIFICATION, TESTING & DOCUMENTATION PROCEDURES

Changes to RA2 Residential HERS Verification, Testing, and Documentation Procedures (some of the changes are also applicable to NA1 HERS verification for duct leakage)

- Updated to eliminate obsolete language; updated the descriptions of the registration procedures
- Add references to JA7 Registry Requirements and RA1 Special Case Protocols
- Reorganized and revised for clarity
- Added the documentation author role in the document registration procedure descriptions for installing contractor and HERS rater
- RA2.3.1.1 added language to clarify whole building compliance approach
- RA2.4.4 clarified procedure for HERS verification compliance when the outdoor temperature is colder than 55F
- RA2.8 Deleted language making HVAC system equivalent to dwelling unit for alterations; added procedure for submittal of certificate of compliance for simple projects as described in Standards Section 10-103(a)2A.

Reference Residential Appendices RA3

RA 3.1 Residential Field Verification and Diagnostic Test Protocols

RA3.1 Procedures for Field Verification and Diagnostic Testing of Air Distribution Systems (some of the changes also apply to NA2 HERS verification of nonresidential duct leakage)

- RA3.1.4.1.1 Revised and expanded Verified Duct Design language for clarity
- RA3.1.4.1.2 Verification of 12 Linear Feet or Less of Duct Located Outside Of Conditioned Space clarified
- RA3.1.4.1.3 Verification of Ducts Located In Conditioned Space clarified
- RA3.1.4.1.4 Verification of Supply Duct Surface Area Reduction clarified
- RA3.1.4.1.5 Verification of Buried Ducts on The Ceiling R-Value clarified
- RA3.1.4.1.6 Verification of Deeply Buried Ducts R-Value clarified

Reference Residential Appendices RA3

Residential Field Verification and Diagnostic Test Protocols

RA3.1 Procedures for Field Verification and Diagnostic Testing of Air Distribution Systems (some of the changes also apply to NA2 HERS verification of nonresidential duct leakage)

- Table RA3.1-2 – Duct Leakage Verification and Diagnostic Tests Protocols and Compliance Criteria updated
  - Sealed and tested new duct systems in multi-family homes regardless of duct system location: Total Duct Leakage ≤ 12% - (new)
  - Sealed and tested new duct systems in multi-family homes regardless of duct system location: Leakage to Outside ≤ 6% - (new)
  - (RA3.1.4.3.5) 60% Reduction in Leakage protocol – deleted
- Deleted labeling requirement from the RA3.1.4.3.5 Sealing of All Accessible Leaks protocol.

Reference Residential Appendices RA3

Residential Field Verification and Diagnostic Test Protocols

RA3.1 Procedures for Field Verification and Diagnostic Testing of Air Distribution Systems (some of the changes also apply to NA2 HERS verification of nonresidential duct leakage)

- RA3.1.4.3.8 Verification of Low Leakage Ducts in Conditioned Space - clarified
- RA3.1.4.3.9 (was RA3.1.4.3.10) Verification of Low Leakage Air Handler with Sealed and Tested Duct System – updated to reference the Appendix JA9 qualification requirements which reference the ASHRAE Standard 193 test method.
- RA3.1.4.4 Verification of Mandatory Return Duct Design required by Section 150.0(m)13 – new
- RA3.1.4.5 verification of Mandatory Air Filter Device Design required by Section 150.0(m)12 - new
- RA3.1.4.6 Verification of Bypass Prohibition – new

Reference Residential Appendices RA3

Residential Field Verification and Diagnostic Test Protocols

RA3.2 Procedures for Determining Refrigerant Charge for Split System Space Cooling Systems Without a Charge Indicator Display

- RA3.2.2.2 Temperature sensor accuracy changed to ± 1.8°F; and temperature sensor response specifications added
- RA3.2.2.3 Digital gages specified (analog gages no longer allowed) – new
- RA3.2.2.3 STMS alternative deleted, and SPMS alternative added – new
- RA3.2.2.6 Revised to improve clarity; compliance tolerance for passing HERS verification widened "to allow for inevitable differences in measurements"

Reference Residential Appendices RA3

Residential Field Verification and Diagnostic Test Protocols

RA3.2 Procedures for Determining Refrigerant Charge for Split System Space Cooling Systems Without a Charge Indicator Display

- RA3.2.2.7 Minimum System Airflow for valid Refrigerant Charge Verification: Temperature split method is deleted; for newly constructed buildings, minimum airflow verification relies on compliance with 150(m)13 duct design or Fan Watt Draw (new); for altered systems verification relies on compliance with 300 cfm/ton nominal cooling capacity using RA3.3 airflow measurement methods.

- RA3.2.3 Weigh-in Procedure: Now allowed at any temperature when the Standard Charge Measurement cannot be used – (new)

- Table RA3.2-3: Temperature Split Table (deleted)

Reference Residential Appendices RA3

RA 3.3 Residential Field Verification and Diagnostic Test Protocols

RA3.3 - Field Verification and Diagnostic Testing of Forced Air System Fan Flow and Air Handler Fan Watt Draw and System Airflow

- RA3.3.1 Instrumentation Specifications updated
- RA3.3.2.1.2 Flow Capture Hood device and measurement procedure – (was deleted in 45-day language). However, Staff is considering recommending that non-powered flow hood devices continue to be allowed; Staff anticipates recommending new requirements for manufacturer s to provide certification to the Energy Commission of flow hood accuracy (new), and submittal of manufacturers' specifications documentation for use of their flow hoods on residential single and multiple-return system return grilles (new)
- RA3.3.2.1.2 Powered Flow Capture Hood device and measurement procedure - added
- RA3.3.2.2.3 Digital Utility Revenue Meter Measurement device and measurement procedure - added

Reference Residential Appendices RA3

RA 3.4 Residential Field Verification and Diagnostic Test Protocols

RA3.4 Procedures for Verifying the Presence of a Charge Indicator Display or High Energy Efficiency Ratio Equipment

- RA3.4.2 CID verification procedures added
  - RA3.4.2.1 Verification of installation of a CID with "self diagnostic reporting" functionality when outdoor air temperature is less than 55F.
  - RA3.4.2.2 Verification of Installation of a CID that does not have "self diagnostic reporting" functionality when outdoor air temperature less than 55F.
  - RA3.4.2.3 Verification of Installation of a CID when the outdoor air temperature is greater than 55F.
- RA3.4.4. Matched Equipment Procedure – added language to direct use of AHRI Directory or other approved directories for verification of space conditioning system ratings for higher SEER or EER when required for compliance.

Reference Residential Appendices RA3

RA 3.5 Residential Field Verification and Diagnostic Test Protocols

RA3.5 - Quality Insulation Installation Procedures

- Updated and separated the Quality Insulation Installation procedures for individual insulation types.
  - New Terminology section applies to all insulation systems

Reference Residential Appendices RA3

Residential Field Verification and Diagnostic Test Protocols

RA3.7 Field Verification and Diagnostic Testing of Mechanical Ventilation Systems

- New section to specify instrumentation and verification protocols for ASHRAE 62.2 whole-building mechanical ventilation airflow.

- RA3.7.4.1.1 Exhaust Systems: continuous operation – airflow to be verified by measurement using available instruments that meet the specified accuracy.
- RA3.7.4.1.2 Supply Systems – system products and verification protocols may be approved by the Commission for use if manufacturers' submitted evidence demonstrates the system operation conforms to ASHRAE 62.2 requirements; approved devices and verification protocols shall be listed in directories published by the Energy Commission.
- RA3.7.4.1.3 Intermittent Systems – system products and verification protocols may be approved by the Commission for use if manufacturers' submitted evidence demonstrates the system operation conforms to ASHRAE 62.2 requirements; approved devices and verification protocols shall be listed in directories published by the Energy Commission.

Reference Residential Appendices RA3

Residential Field Verification and Diagnostic Test Protocols

RA3.8 Field Verification and Diagnostic Testing of Building Air Leakage

- Procedure to measure air tightness of a building envelope to verify reduced building air leakage.
  - Measured in cubic feet per minute at a 50 Pa pressure difference (CFM50).
- Procedure described in this section is derived from Residential Energy Services Network's (RESNET) Mortgage Industry National Home Energy Rating Standards, Standard 800.

Reference Residential Appendices RA5

RA5 INTERIOR MASS CAPACITY

- Section removed, Interior Mass Capacity no longer being used to calculate the benefits of thermal mass
  - Res ACM manual to provide thermal mass modeling guidance

Reference Nonresidential Appendices NA2

NA2 - Nonresidential Field Verification and Diagnostic Test Procedures (duct leakage for small constant volume systems that meet the criteria of Section 140.4(l))

- Updated to eliminate ACM language; edited for clarity throughout
- Added Smoke test apparatus specification.
- Clarified that connections to plenums, and penetrations in air-handling unit, and air-handling unit access door must be sealed prior to performing the duct leakage test.
- Revised NA2.1.4.2.2 Sealing of All Accessible Leaks protocol to include smoke test.
- Added NA2.1.4.2.3 smoke test protocol.
- Revised NA2.1.4.2.4 Visual Inspection to delete “excessively damaged” inspection criteria that included allowance for systems to pass the verification with 2-inch diameter holes in ducts.
- Eliminated requirement for affixing a sticker to the duct system to report the results of the duct leakage test.

Reference Nonresidential Appendices NA5

NA5 OVERALL ENVELOPE TDV ENERGY APPROACH

- Section removed, staff developing a simplified tradeoff procedure to be incorporated into the nonres ACM manual

Reference Nonresidential Appendix NA7

NA7 Acceptance Requirements for Nonresidential Buildings

Changes to Nonresidential appendix NA7

- Add table of contents
- NA7.2 revise introduction for clarity
- NA7.3 roles and responsibilities – revised
  - NA7.3.1 Responsible Person - clarified
  - NA7.3.2 Field Technician - new
  - Documentation Author – new
- Revised acceptance tests
- New acceptance tests

Reference Nonresidential Appendix NA7

NA7 Acceptance Requirements for Nonresidential Buildings

Revised Acceptance Tests

- NA7.4.1.2 Required Documentation

  Commission's Fenestration Label Certificate – *Elements Requiring Verification* and *Required Documentation* clarified

- NA7.5.1.1 VAV Outdoor Air Acceptance
  - Expanded construction inspection to include outdoor air flow sensor and controls, calibration certificates, pre-occupancy purge
  - Functional testing clarified
- NA7.5.1.2 Constant Volume System Outdoor Air Acceptance
  - Expanded construction inspection to include outdoor air provisions and pre-occupancy purge

Reference Nonresidential Appendix NA7

NA7 Acceptance Requirements for Nonresidential Buildings

Revised Acceptance Tests

- NA7.5.3 Air Distribution Systems
  - Expanded construction inspection to include duct systems, adhesive tape
- NA7.5.4 Economizer Controls
  - Expanded construction inspection to include sensors, dampers, thermostats, actuators
  - Functional tests added to confirm damper position control and economizer use for partial cooling
- NA7.5.6 Supply Fan Variable Flow Controls
  - Expanded construction inspection to include airflow modulation device
  - Functional test clarified

Reference Nonresidential Appendix NA7

NA7 Acceptance Requirements for Nonresidential Buildings

Revised Acceptance Tests

- NA7.5.8 Supply Water Temperature Reset Controls
  - Functional test clarified
- NA7.5.9 Hydronic System Variable Flow Controls
  - Expanded construction inspection to include static pressure location, setpoint and reset control
  - Functional test steps reordered and clarified
- NA7.5.11 Fault Detection and Diagnostics for DX Units
  - Expanded construction inspection to include hardware, air temperature sensors, controller
  - Removed Eligibility Criteria
  - Added functional tests for air temperature sensors, excess outside air, economizer operation, refrigerant diagnostic sensors

Reference Nonresidential Appendix NA7

NA7 Acceptance Requirements for Nonresidential Buildings

New Acceptance Tests

- NA7.5.15 Supply Air Temperature Reset
- NA7.5.16 Condenser Water Supply Temperature Reset Controls
- NA7.10 Refrigerated Warehouse Refrigeration Systems
  - NA7.10.1 Electric Resistance Underslab Heating System
  - NA7.10.2 Evaporators and Evaporator Fan Motor Variable Speed Control
  - NA7.10.3 Condensers and Condenser Fan Motor Variable Speed Control
  - NA7.10.4 Variable Speed Screw Compressors

Reference Nonresidential Appendix NA7

NA7 Acceptance Requirements for Nonresidential Buildings

- NA7.6 Indoor Lighting Acceptance Requirements
  - Automatic Daylight Controls
  - Automatic Shutoff Controls
  - Demand Responsive Controls

Reference Nonresidential Appendix NA7

NA7 Acceptance Requirements for Nonresidential Buildings

- NA7.7 Lighting Control Installation Requirements
  - NA7.7.1 Lighting Control Systems
  - NA7.7.2 EMCS
  - NA7.7.3 Track Lighting Integral Current Limiter
  - NA7.7.4 Track Lighting Supplementary Overcurrent Panels
  - NA7.7.5 Interlocked Systems Serving a Single Area
  - NA7.7.6 To Use Power Adjustment Factors (PAF)
  - NA7.7.7 Videoconferencing Studio Extra Power Allowance
- NA7.8 Outdoor Lighting Acceptance Requirements
  - Outdoor Lighting Automatic Shutoff Controls

Reference Nonresidential Appendix NA7

NA7 Acceptance Requirements for Nonresidential Buildings

New Acceptance Tests

- NA7.11 Commercial Kitchen Exhaust Systems
  - NA7.11.1 Kitchen Exhaust Systems with Type I Hood Systems
- NA7.12 Parking Garage Ventilation Systems
- NA7.13 Compressed Air Systems

Reference Nonresidential Appendix NA8

NA8 Luminaire Power

- Significantly reduced in scope

Reference Nonresidential Appendix NA9

NA9 Nonresidential Fault Detection and Diagnostics (FDD) - NEW

Specifies the requirements of FDD systems for economizer operation of air-cooled DX units (required in code section 120.2(i))

- NA9.1 System Requirements
  - Temperature and refrigerant pressure sensors
  - Unit controller shall display sensor values
  - Unit controller shall provide system status for:
    - Free cooling
    - Economizer enabled
    - Compressor enabled
    - Heating enabled
    - Mixed air low limit cycle active
  - Unit controller shall manually initiate each operating mode
  - Faults reported to management application
  - FDD system shall be certified by the Commission

Reference Nonresidential Appendix NA9

NA9 Nonresidential Fault Detection and Diagnostics (FDD) - NEW

Specifies the requirements of FDD systems for economizer operation of air-cooled DX units (required in code section 120.2(i))

- NA9.2 Faults to be Detected
  - Air temperature sensor failure/fault
  - Not economizing when it should
  - Economizing when it should not
  - Damper not modulating
  - Excess outdoor air

Reference Appendices
COMMENTS

Residential ACM Approval Manual

- Compliance Software vendor requirements
  - Use of Commission provided simulation engine and performance rules processor (aka *Compliance Manager*)
  - Application checklist
  - Compliance supplement to software user's manual
- Processes for approval, decertification and challenges

Residential ACM Approval Manual

- Application checklist
  - Vendor certification statement
  - Computer run results and summary sheets for certification tests
  - Compliance Supplement
  - Copy of Compliance Software
  - Application fee
    - Staff proposes to reduce from $2,000 to $1,000

Nonresidential ACM Approval Manual

- Compliance Software vendor requirements
  - Application checklist
  - Compliance supplement to software user's manual
- Processes for approval, decertification and challenges

ACM Approval Manuals

COMMENTS

GENERAL
COMMENTS